Autonomous Undersea Observations

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Contract Number: N00014-05-C-0104

LONG-TERM GOALS

The U.S. Navy requires advances in environmental sensing over extended areas and over time, or so-called 4-D sensing. The goal is to provide more capable, better integrated, and less expensive sensor systems for a variety of applications, including measurement of physical characteristics of the ocean, threat detection, and timely transmission of the data to end users.

OBJECTIVES

The original objective of this program was the development of a generic capability to support multiple autonomous environmental sensors within an acoustic modem-based infrastructure capable of communicating to and from the sensors and to and from the outside world. The outside world would be either an adjacent node (e.g., a Seaweb node) or a surface buoy. The focus of this effort has narrowed to the development of two devices: one is an integrated ADCP/modem, and the other is a self-contained ASW sonar and modem.

APPROACH

Benthos has a multi-year history of developing modem-based underwater systems, including devices/technology for navigation, covert signaling, markers, networks, and telesonar with high speed platforms. This effort is concentrating on the development and demonstration of the two modem-based sensors. We have teamed with Teledyne RDI for their current and wave monitoring technology and to modify their Workhorse ADCP to incorporate a Benthos modem and burn-wire release which as a single unit may be easily deployed and recovered over the side of a small boat. The ASW modem is an in-house effort which provides in-situ signal processing appropriate for a passive sonar function, with “alerts” and data snippets being sent to the outside world via acoustic telemetry.

WORK COMPLETED

The ADCP/modem integration is now in a second prototype package, as shown in Figure 1. The first of two units was just received from RDI, and Benthos is now concentrating on the final assembly and calibration. We are contracting with Dr. Eric Terrill of MPL/Scripps at UCSD to assist us in the deployment, testing, and data analysis of this device, which is tentatively scheduled for mid November 2007.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2007	**Annual**	**00-00-2007 to 00-00-2007**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Autonomous Undersea Observations	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Teledyne Benthos inc.,49 Edgerton Dr.,North Falmouth,MA,02556**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
code 1 only

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

The ASW Modem has gone through two phases. In the first, the DSP in a standard SM 75 modem (a modem, acoustic release, and DSP resource contained within a self-buoyant glass sphere) was programmed to process acoustic signature data within the modems operating band (e.g., 9-14 kHz), to set detection thresholds, and to collect certain event information when the thresholds were exceeded. The stored data were then retrieved by a Slocum Glider acting as a data truck. This was demonstrated to ONR in mid-2006. The second phase involves the integration of a spherical transducer in place of the standard cylindrical variety, and the accompanying integration of a parallel DSP processing board. The transducer is tuned for transmissions in our standard C band (22 - 27 kHz), while being very broad band in reception, especially at lower frequencies. The processing board is a replica of a standard modem TMSC5510 DSP-based digital board, but is used exclusively for sonar signal processing, especially at lower frequencies. This device also now supports recording of the complex time series of the basebanded version of any selected band of interest. Up to 8 Gbyte may be recorded. We have also modified the front end to operate to as low as 100 Hz. Figure 2 shows a photograph of the completed integration (this figure is the same as shown last year, but the internal electronics are substantially different). A second sonar modem is now under construction, and a demonstration is anticipated for early in CY '08.

RESULTS

We have been extremely delayed in the completion of these systems. In particualr, the ADCP modem has reverted to a standard COTS package for RDI as they were unable to adapt to the spherical design previously developed and considerable time was devoted to obtaining agreement on the final form factor. As well, we have encountered difficulties in obtaining parts for our newest generation of modem, and both devices were target applications for this new modem. The production of the sonar modem had to await avaiilability of part, as the older modem was not sufficiently capable to satisfy our objectives. The requisite parts are expected by mid to late November 2007. However, the older, 3rd generation modem was eventually deemed to be sufficient for the ADCP modem, and that is now being incorporated into the unit.

RELATED PROJECTS

Benthos is involved with a variety of Navy programs involving acoustic communications (acomms), and the development of systems which use acomms. Benthos modems have been placed on crawlers, AUVs and submarines. We have enhanced the ability of the modem to support operations with submarine targets with range rate of up to 30 kts (NUWC Keyport, Mr. Doug Ray). We successfully demonstrated our A.O. FNC-funded underwater GPS navigation aid at AUVFEST 2007. Benthos has recently completed a Phase 2 SBIR program (Dr. Tom Swean) for the development of a "smart marker" using modem technology to enhance object markers now in use in MCM activities. This likewise was successfully demonstrated at AUVFEST. Benthos has yet another Phase 2 SBIR for developing a modem-based position aid (Dr. Tom Swean, ONR). Both of these developments are continuing under Phase 3 and Phase 2 (Options). Benthos has for 9 years support SPAWAR/ONR (Mr. Joe Rice) in the Telesonar/Seaweb program which has developed an extensive undersea networking capability based around Benthos modems. Finally, Benthos is developing a modem-based portable tracking range for NUWC Keyport Division (Mr. Doug Ray)

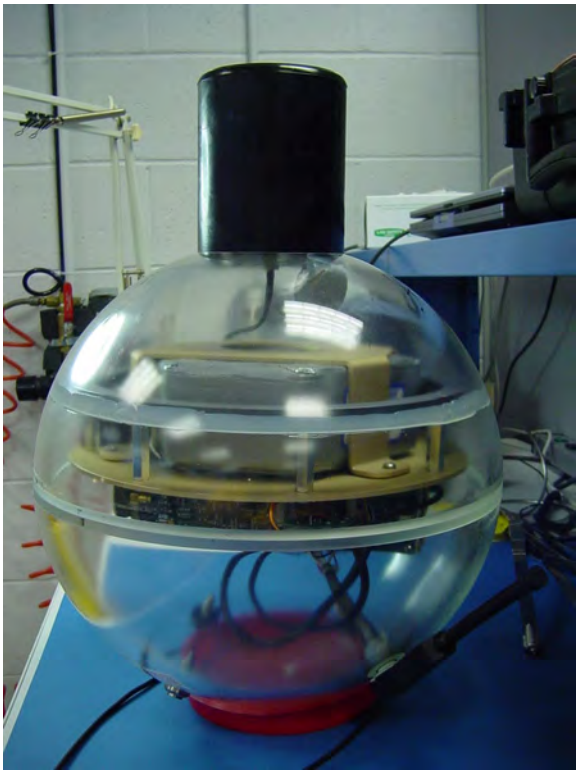

Figure 1. Teledyne Benthos' ASW Modem

Figure 2. Teledyne Benthos' and Teledyne RDI's Integrated ADCP Modem